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Dakin et al.

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(54) **SHROUDED ELECTRIC LAMP HAVING FUNCTIONALLY DISTINGUISHABLE CENTER SUPPORTS**

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(52) **U.S. Cl.** **313/25**; 313/634
(58) **Field of Search** 313/25–26, 634–635, 313/13, 17, 27, 47, 492, 493, 624–626, 637, 638, 639, 642, 643

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,161,672	A		7/1979	Cap et al.
4,281,274	A		7/1981	Bechard et al.
4,499,396	A		2/1985	Fohl et al.
4,721,876	A		1/1988	White et al.
4,935,668	A		6/1990	Hansler et al.
4,950,938	A		8/1990	Ramaiah
5,023,506	A		6/1991	Canale et al.
5,043,623	A		8/1991	Scholz et al.
5,065,069	A		11/1991	Hunter
5,075,588	A		12/1991	Hunter
5,122,706	A		6/1992	Parrott et al.
5,252,885	A		10/1993	Muzeroll et al.
5,270,608	A		12/1993	Williamson et al.
5,296,779	A		3/1994	Muzeroll
5,334,906	A		8/1994	Muzeroll
5,340,346	A		8/1994	Muzeroll
5,493,167	A		2/1996	Mikol et al.
5,550,421	A		8/1996	Scholz et al.
5,576,592	A		11/1996	Koenigsberg et al.
5,610,469	A		3/1997	Bergman et al.
5,719,463	A		2/1998	Hassink et al.
5,998,915	A	*	12/1999	Scholz et al. 313/234
6,242,851	B1	*	6/2001	Zhu et al. 313/25

* cited by examiner

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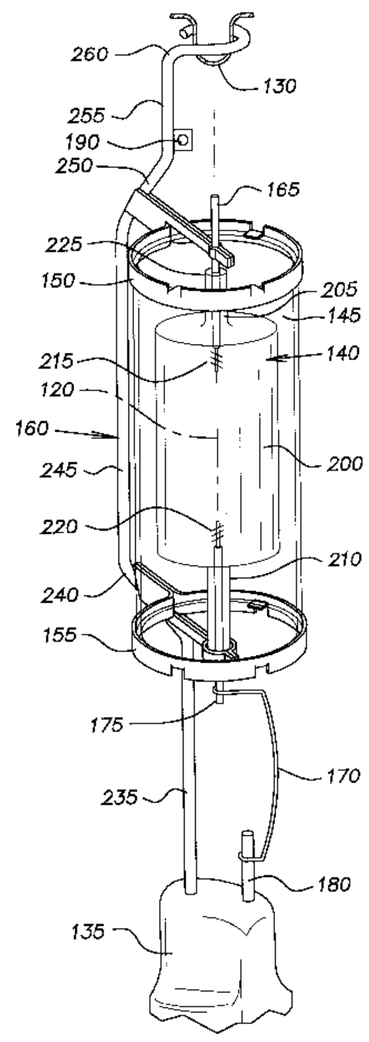
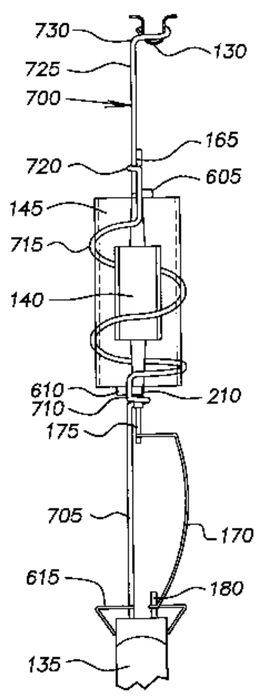
(57) **ABSTRACT**

An electric lamp **(100)** including a sealed light-transmissive lamp envelope **(105)** having an interior space, a base fixed to the outer envelope **(105)**, a non-insulated main conductor wire **(160)** within the outer envelope and connected to the base **(110)** at one end, a light source **(140)** capable of generating light within the outer envelope **(105)**, a shroud **(145)** surrounding the light source **(140)** and mounted adjacent the non-insulated main conductor wire **(160)**, and a first center support. The light source **(140)** has first and second ends. The first end is electrically coupled to the non-insulated main conductor wire **(160)**, and the second end is coupled to a stem lead **(180)**. The first center support **(150)** supports the shroud **(145)** and the light source **(140)** and mechanically couples the shroud **(145)** and the light source **(140)** to the non-insulated main conductor wire **(160)**.

16 Claims, 4 Drawing Sheets





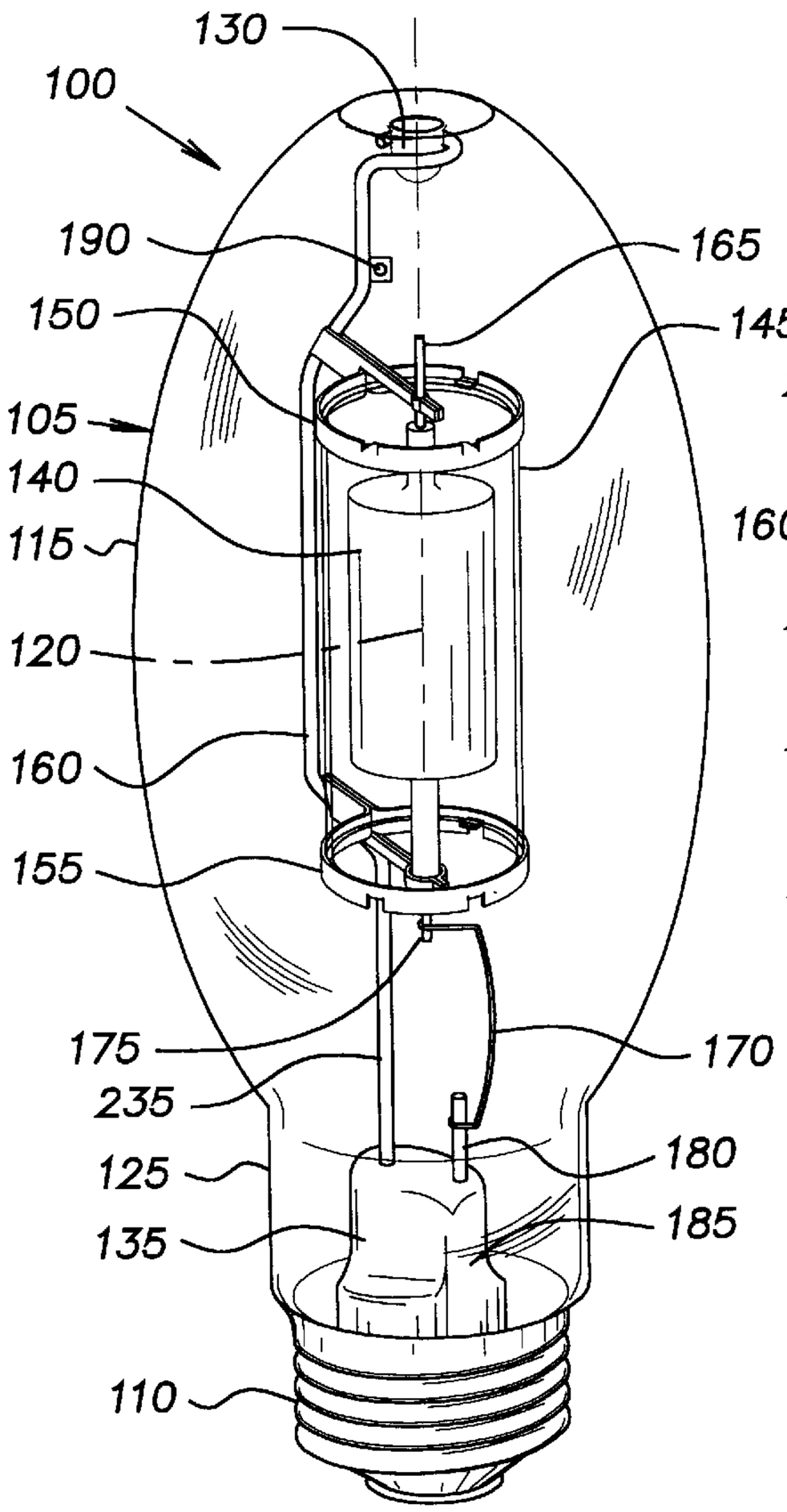

130
100
190
165
150
145
105
140
115
120
160
155
175
170
235
180
125
185
135
110

FIG. 1

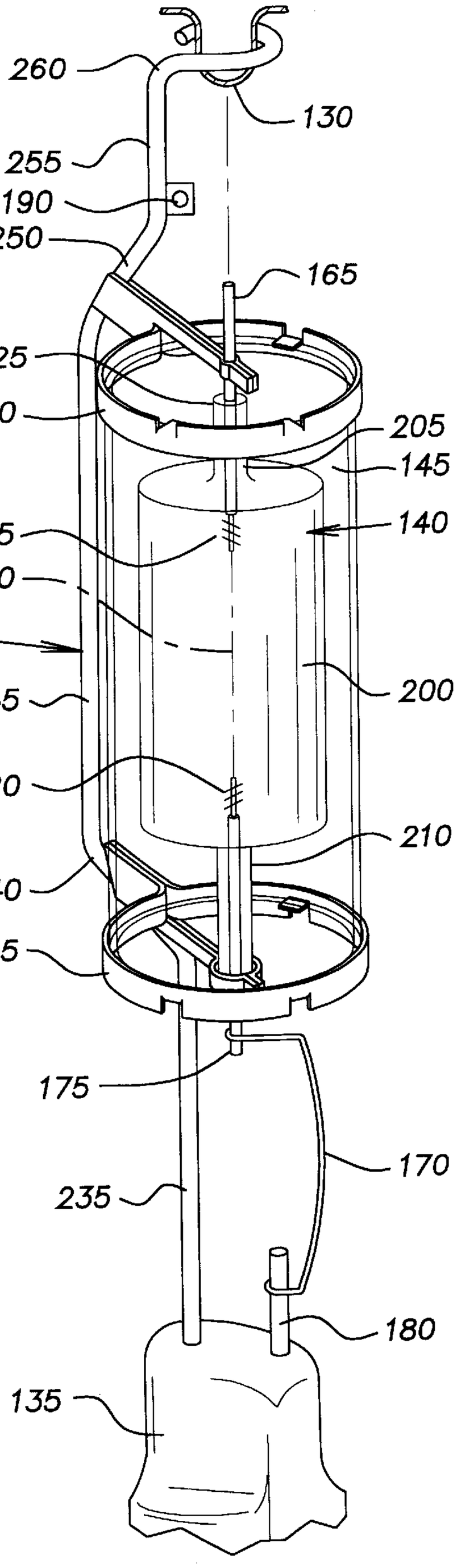

260
130
255
190
250
165
225
150
205
145
140
215
120
160
200
245
220
210
240
155
175
170
235
180
135

FIG. 2

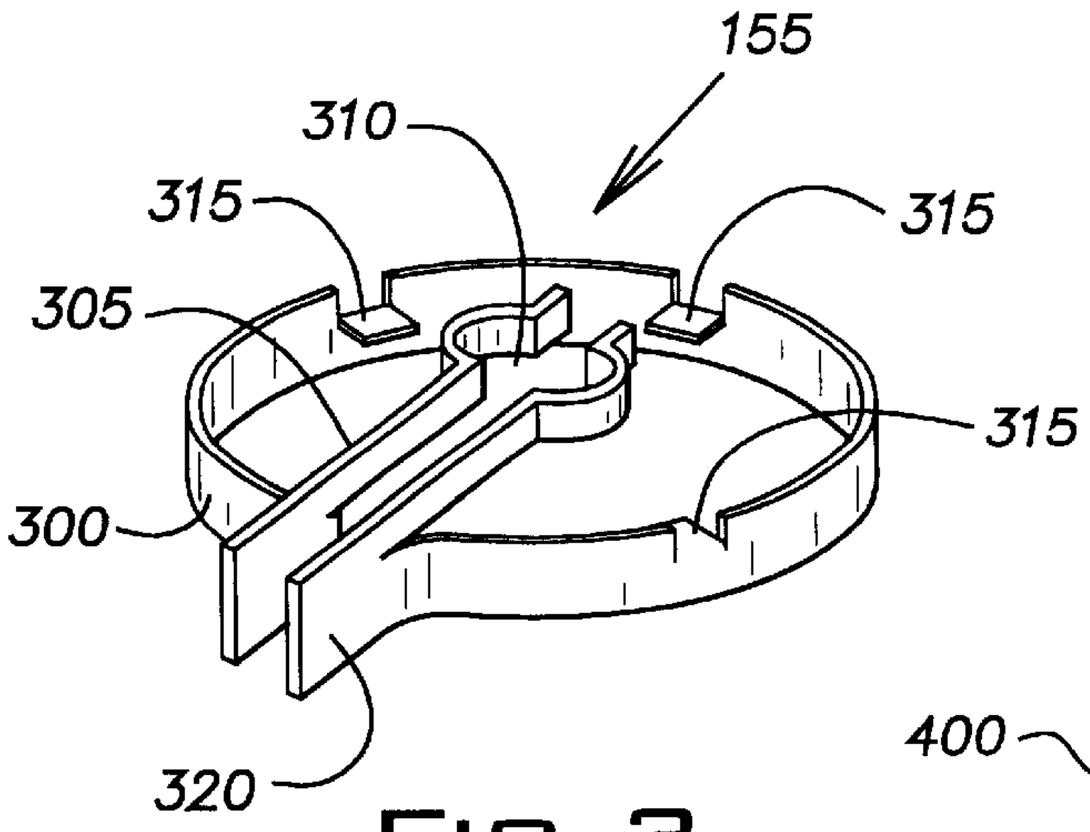


FIG. 3

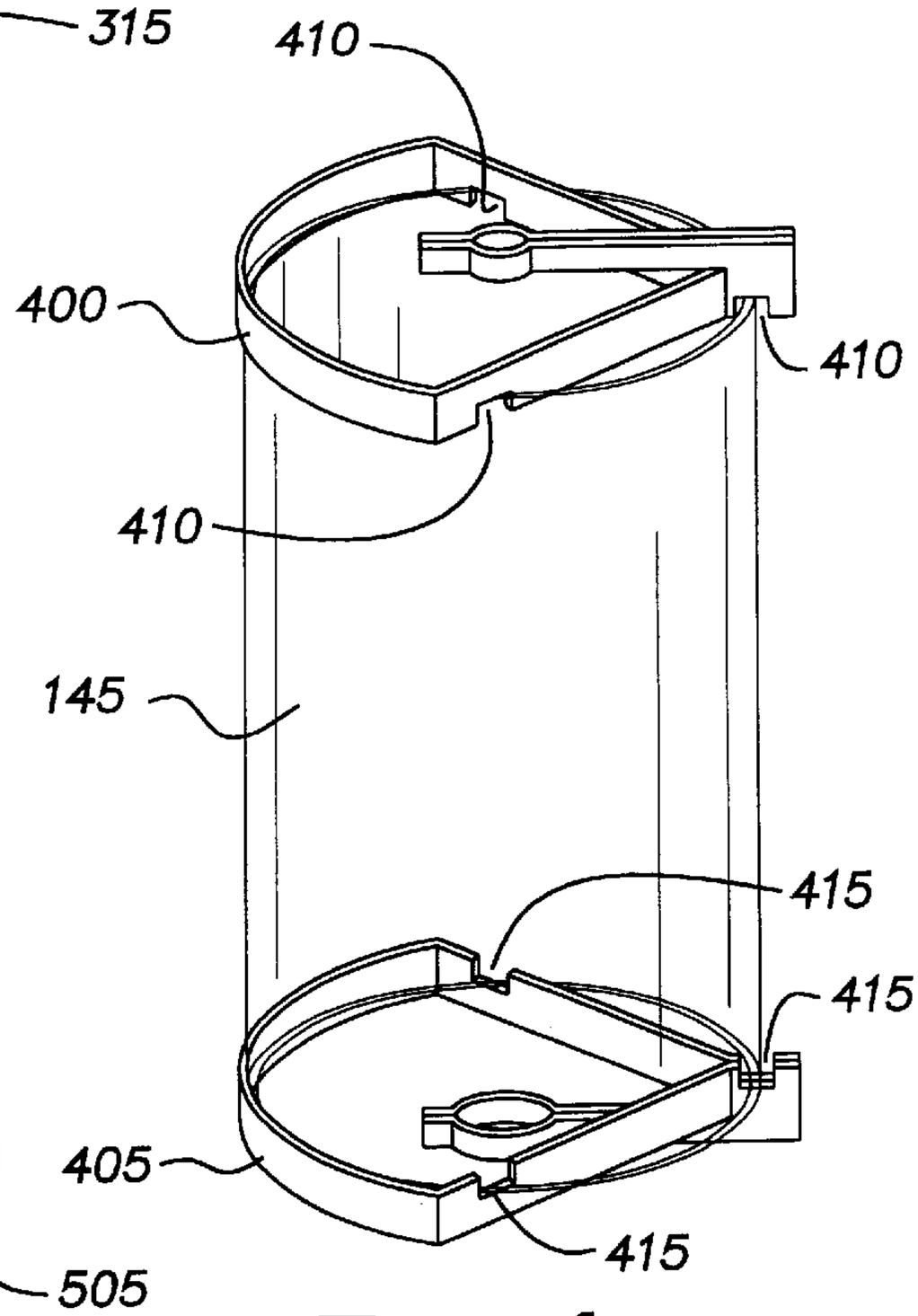


FIG. 4

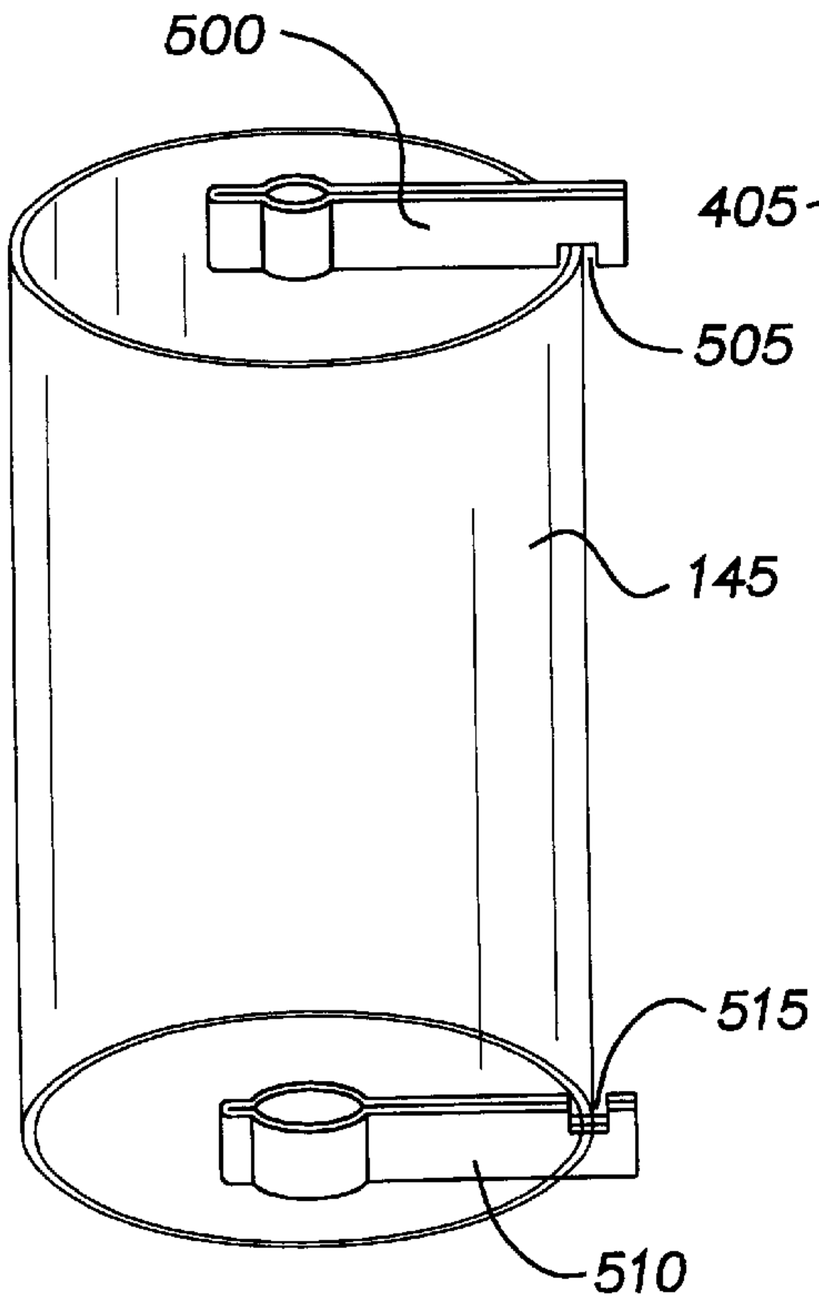


FIG. 5

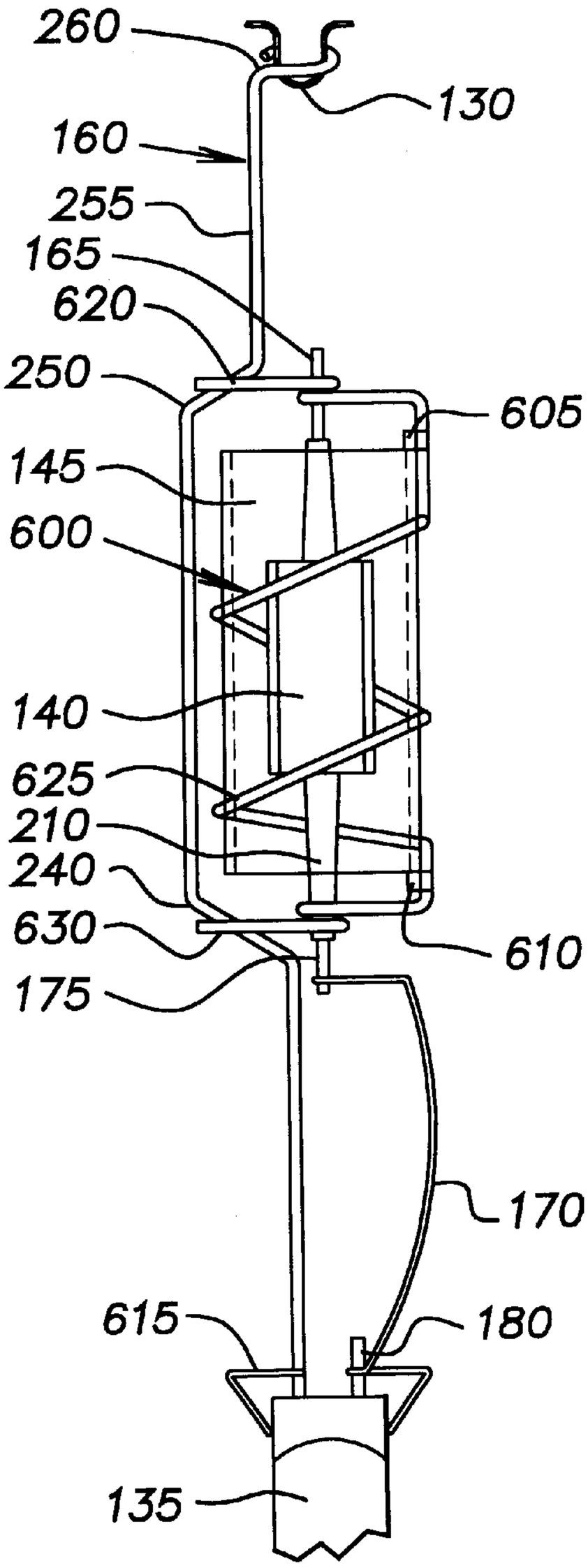

260
130
160
255
165
620
250
605
145
600
140
625
210
240
630
610
175
170
615
180
135

FIG. 6

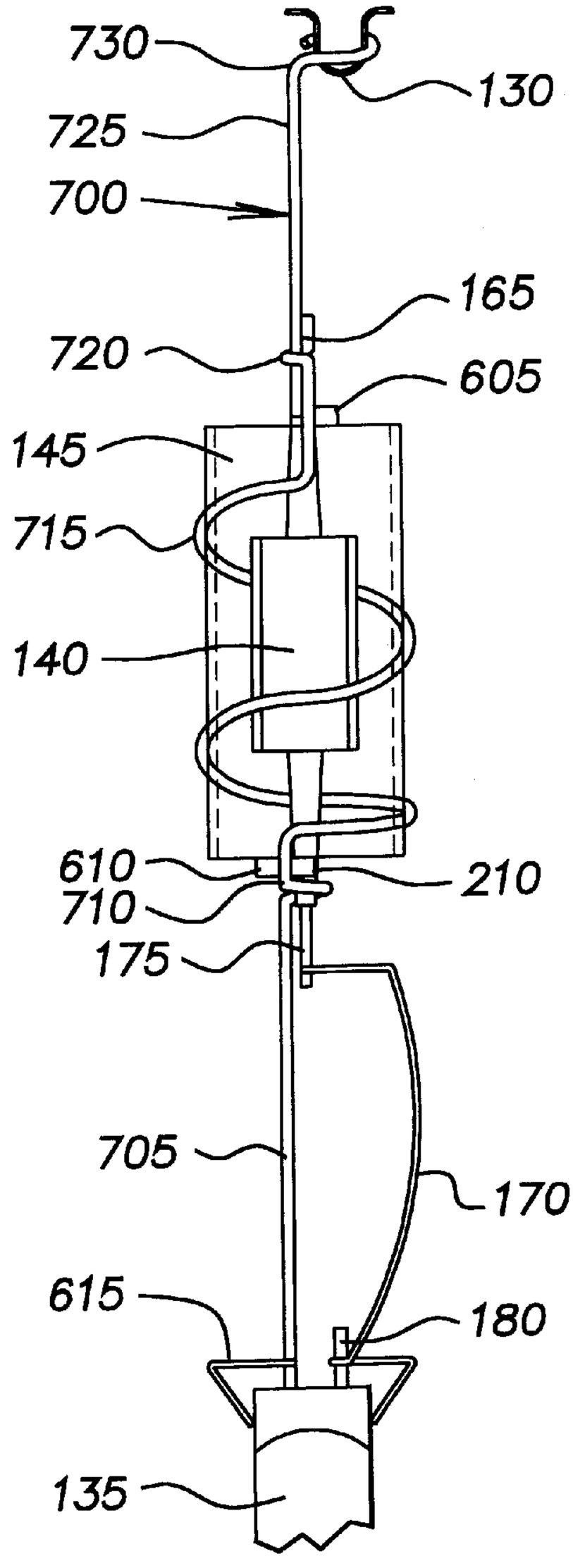

730
130
725
700
165
720
605
145
715
140
610
210
710
175
705
170
615
180
135

FIG. 7

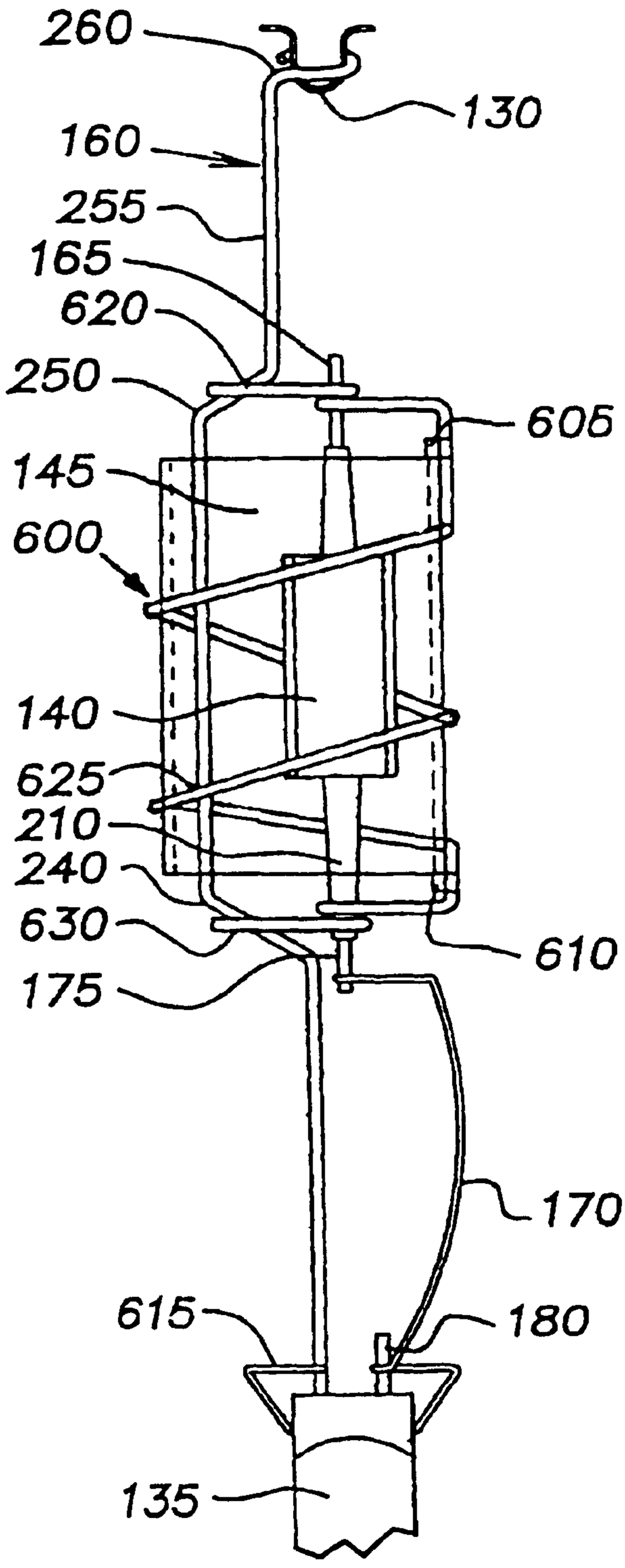

260
130
160
255
165
620
250
605
145
600
140
625
210
240
630
610
175
170
615
180
135

FIG. 8

SHROUDED ELECTRIC LAMP HAVING FUNCTIONALLY DISTINGUISHABLE CENTER SUPPORTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This application relates to electric lamps and in particular, to electric lamps having shrouds.

2. Discussion of the Art

Metal halide arc discharge lamps are frequently employed in commercial usage because of their high luminous efficacy and long life. A typical metal halide arc discharge lamp includes a quartz or ceramic arc tube that is hermetically sealed within a glass jacket or outer envelope. The arc tube, itself hermetically sealed, has tungsten electrodes frit or press sealed in opposite ends and has a bulb portion containing fill material including mercury, metal halide additives, and a rare or noble gas to facilitate starting. The outer envelope is either evacuated or filled with nitrogen or another inert gas at less than atmospheric pressure.

The metal halide arc tube is often surrounded with a shroud which comprises a generally cylindrical tube of light-transmissive material, such as quartz, that is able to withstand high operating temperatures. The arc tube and the cylindrical shroud are coaxially mounted within the lamp outer envelope with the arc tube located within the shroud. The shroud improves the safety of the lamp by acting as a containment device in the event that the arc tube shatters. The shroud allows the lamp outer envelope to remain intact by dissipating the energy of a shattering arc tube. The presence of a shroud expands the market for metal halide lamps into open-type (absence of an expensive cover plate) lighting fixtures.

Sodium is an important constituent in metal halide arc discharge lamps, usually in the form of sodium iodide. Sodium is used to improve the efficacy and color rendering properties. It has long been recognized that quartz arc tubes containing sodium lose sodium during operation by movement or migration through the arc tube wall. The iodine originally present in a metal halide arc discharge lamp as sodium iodide is freed by sodium loss, and the iodine combines with mercury in the arc tube to form mercury iodide. Mercury iodide leads to increased reignition voltages, thereby causing starting and lamp maintenance problems and shortening lamp life.

There is evidence that most of the sodium loss is due to a negative charge on the arc tube walls caused by photoelectric emission from electrified side rods used to support the arc tube and shroud within the outer envelope. Solutions to this problem are known in the art. See, for example, U.S. Pat. No. 5,493,167, where a ceramic sleeve and insulator support stops are used to prevent sodium loss. While such lamp constructions provide an improvement, the structures are complex and still require a relatively high number of parts and/or welds, making them difficult to assemble.

Accordingly, a need exists for a more efficient lamp construction.

BRIEF SUMMARY OF THE INVENTION

In accordance with the present invention, the improved electric lamp includes a sealed light-transmissive outer envelope having an interior space, a base fixed to the outer envelope, a non-insulated main conductor wire within the outer envelope and connected to the base at one end, a light source capable of generating light within the outer envelope, a shroud surrounding the light source and mounted adjacent the non-insulated main conductor wire, and a first center support. The light source has first and second ends. The first end is electrically coupled to the non-insulated main conductor wire, and the second end is coupled to a stem lead. The first center support supports the shroud and the light source and mechanically couples the shroud and the light source to the non-insulated main conductor wire.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a perspective view of an electric lamp according to the present invention;

FIG. **2** shows a perspective view of the mount assembly used in the electric lamp of FIG. **1**;

FIG. **3** shows a perspective view of the lower center support used in the electric lamp of FIG. **1**;

FIG. **4** shows a perspective view of a second embodiment of the center supports used in the electric lamp of FIG. **1**;

FIG. **5** shows a perspective view of yet another embodiment of the center supports used in the electric lamp of FIG. **1**;

FIG. **6** shows an elevational view of a second embodiment of the mount assembly according to the present invention; and

FIG. **7** shows an elevational view of a third embodiment of the mount assembly according to the present invention.

FIG. **8** shows an elevational view of another inventive embodiment of the mount assembly.

DETAILED DESCRIPTION OF THE INVENTION

An electric lamp or electric lamp assembly **100** in accordance with a preferred embodiment of the invention is shown in FIG. **1**. The electric lamp **100** is a metal halide arc discharge lamp and includes a bulb or outer envelope **105** and a base **110**. The outer envelope **105** has a main or dome region or portion **115** elongated along a central lamp axis **120** and a neck region or portion **125**. The dome portion **115** may also be a cylindrical or tubular extension of the neck portion **125** terminating in a rounded top. The dome portion **115** preferably has a dimple **130** along the central lamp axis **120** at the upper end of the outer envelope **105** (as viewed). The neck portion **125** has an inside diameter generally perpendicular to the central lamp axis **120**. The outer envelope **105** is typically formed of a blow molded hard glass such as borosilicate. The base **110** includes a glass stem **135**, which is hermetically sealed to the outer envelope **105**. The glass stem **135** extends into the neck portion **125** along the central lamp axis **120**. The base **110**, formed for easy connection to an electrical source, is fixed to the outer envelope **105**.

Contained within the interior space of the outer envelope **105** is a mount assembly. The mount assembly includes a light source, lamp capsule, or arc tube **140**, a shroud **145**, an upper center support **150**, a lower center support **155**, and a first or non-insulated main conductor wire **160**. The non-insulated main conductor wire **160** is electrically conductive and is not surrounded by an insulative material, such as a sleeve.

As shown in FIGS. **1** and **2**, the upper center support **150** supports the shroud **145** and the arc tube **140** and mechanically couples the shroud **145** and the arc tube **140** to the non-insulated main conductor wire **160**. Further, the upper center support **150** electrically connects the non-insulated

main conductor wire to a first or upper electric or electrode lead **165** of the arc tube **140**, and a second conductor wire **170** couples a second or lower electric or electrode lead **175** of the arc tube **140** to an electrical conductor or stem lead **180**. The non-insulated main conductor wire **160** and the stem lead **180** pass through the stem **135** and are sealed by a stem press **185** as is known in the art. Alternatively, the non-insulated main conductor wire **160** may be coupled to a second stem lead which passes through the stem **135**. As shown in FIG. **1**, the non-insulated main conductor wire **160** and the stem lead **180** are electrically connected to the base **110** external of the outer envelope **105** to provide access for energization of the lamp.

As is well known, getters are important in any structure wherein an evacuated or inert gas environment is desired. Thus, a getter may be positioned within the outer envelope **105**. For example, a zirconium aluminum getter **190** may be positioned within and at the upper end of the outer envelope **105** (as viewed) generally between the top end of the shroud **145** and the dimple **130**. A second embodiment of a getter will be discussed below.

FIG. **2** shows an enlarged view of the mount assembly. The arc tube **140** is disposed substantially within an interior space or cavity of the shroud **145**. The arc tube **140** includes a bulb portion **200** and upper and lower leg portions **205** and **210**. Contained within the arc tube **140** are two electrodes **215** and **220** located at opposite ends of the bulb portion **200** and attached to the upper and lower electrode leads **165** and **175** which extend through the upper and lower leg portions **205** and **210**, respectively. Frit seals **225** are located opposite the upper and lower electrode ends of the bulb portion **200** and seal the upper and lower electrode leads **165** and **175** to provide sealed electrical feed-throughs to the electrodes **215** and **220**. The bulb portion **200**, which encloses a sealed discharge region which contains a suitable fill material for maintaining an arc discharge, is disposed within the interior cavity of the shroud **145**. It will be noted that in other types of lamp assemblies, the lamp capsule may be of a different configuration. For example, instead of two electrodes **215** and **220**, there may be a filament. Additionally, the frit seals **225** may instead be pinch or press seals.

Preferably, the arc tube **140** is of a cylindrical design. Alternatively, the arc tube may be of an ellipsoidal design such as is disclosed in U.S. Pat. No. 4,161,672, the disclosure of which is expressly incorporated herein in its entirety. The ellipsoidal design does not require the inside diameter of the shroud **145** to be in close proximity of the outside diameter of the arc tube **140** for suitable performance.

It will be noted that the arc tube **140** of the preferred embodiment is a ceramic metal halide arc tube made of a high temperature ceramic material, such as alumina ceramic. This material is useful because ceramic arc tubes assist in suppressing sodium loss. However, the light source **140** may also be a tungsten halogen incandescent lamp or other lamp which is advantageously operated with a shroud.

The shroud **145** is preferably a cylindrically-shaped tube having two ends which are open to an interior space, cavity or zone. Preferably, the shroud **145** is made of a light-transmissive and heat-resistant material, such as fused quartz. The shroud **145** is supported within the outer envelope **105** generally coaxial with the arc tube **140**. The shroud **145** preferably has a length about the same as the distance between the outer ends of the arc tube frit seals **225** and less than the distance between the outer ends of the upper and lower electrode leads **165** and **175**. This length is typically about 82 mm. The shroud **145** typically has a wall thickness of about 2.5 mm, and preferably between about 1.5 mm and about 2.5 mm. The distance between the shroud **145** and the arc tube **140** is typically about 4.5 mm. The shroud **145** must have an inner diameter greater than the outer diameter of the arc tube bulb portion **200**. The inner diameter of the shroud is typically about 30 mm. Preferably, the shroud **145** has a maximum outer diameter only slightly less than the inner diameter of the outer envelope neck portion **125**, that is, the shroud **145** generally has the largest outside diameter that, in combination with the rest of the mount assembly, can be conveniently inserted during manufacturing of the electric lamp **100**. This outer diameter is typically about 35 mm.

The upper and lower center supports **150** and **155** center and support the arc tube **140** and the shroud **145** to the non-insulated main conductor wire **160**. Together, the upper and lower center supports **150** and **155**, the shroud **145**, and the arc tube **145** may form an integral unit or a shroud **145** and arc tube **140** subassembly.

As shown in FIG. **1**, the shroud is mounted adjacent the non-insulated main conductor wire **160**. While the shroud may surround the non-insulated main conductor wire **160**, the non-insulated main conductor wire **160** is preferably located outside of the shroud **145**, as shown in FIGS. **1** and **2**.

The non-insulated main conductor wire **160** has a bottom axial portion **235** parallel to the outer envelope central lamp axis **120** that extends through the stem **135**. Connected to the bottom axial portion is a slanted outward portion **240**, which extends at approximately a 45 degree angle from the central lamp axis **120**. The slanted outward portion is connected to a middle axial portion **245**, which extends adjacent the length of the shroud **145** on the outside of the shroud **145**. At the top end of the shroud **145**, the middle axial portion **245** of the non-insulated main conductor wire **160** becomes a slanted inward portion **250**, which extends at approximately a −45 degree angle from the central lamp axis **120**. The slanted inward portion **250** is connected to a top axial portion **255**. At the end of the top axial portion **255** is preferably an upper terminal loop **260**, which generally encircles the dimple **130** of the outer envelope **105** to limit movement of the arc tube **140** and the shroud **145** within the outer envelope **105** and improve rigidity of the entire assembly. The non-insulated main conductor wire **160** is preferably a continuous wire from the stem **135** to the dimple **130**.

The non-insulated main conductor wire **160** and the stem lead **180** are coupled to the upper and lower electrode leads **165** and **175** via the upper center support **150** and the second conductor wire **170**, respectively. Preferably, the upper and lower center supports **150** and **155** are coupled to the non-insulated main conductor wire **160** at the slanted inward portion **250** and slanted outward portion **240**, respectively, to provide additional support for the upper and lower center supports **150** and **155** by reducing the stress on the upper and lower center supports **150** and **155**. The upper center support **150** supports the arc tube **140** and the shroud **145** and also electrically connects the upper electrode lead **165** to the non-insulated main conductor wire **160**. The lower center support **155** only provides mechanical coupling of the arc tube **140** and the shroud **145** to the non-insulated main conductor wire **160**.

In an alternative embodiment, a second stem lead instead of the non-insulated main conductor wire **160** passes through the stem **135**. The non-insulated main conductor wire **160** may then be electrically coupled to the second stem lead preferably via welding.

As seen in FIG. **3**, the lower center support **155** is formed of four portions. A circular portion **300** generally engages the lower end of the shroud **145**. For example, the circular portion **300** may surround the outer perimeter of the lower end of the shroud **145**. An extension portion **305** generally extends from the circular portion **300** and forms a centering hole **310** through which the lower electrode lead **175** and lower leg portion **210** of the arc tube **140** passes. Tab portions or support tabs **315** fold inward and are substantially perpendicular to the circular portion **300**. A rectangular portion **320** attaches to the non-insulated main conductor wire **160** and is of sufficient width for welding the lower center support **155** to the non-insulated main conductor wire **160**. The upper center support **150** is virtually identical to the lower center support **155**. The only difference between the upper and lower center supports **150** and **155** is that the centering hole in the upper center support **150** is of a smaller diameter than the centering hole **310** in the lower center support **155** since only the upper electrode lead **165** passes through the centering hole. The upper and lower center supports **150** and **155** generally position or locate the arc tube **140** coaxially and laterally within the shroud **145**. Further, the upper center support **150** acts as an electrical conductor between the upper electrode lead **165** and the base **110**. To insure a proper electrical connection, the upper center support **150** may be welded or crimped to the upper electrode lead **165**. The upper and lower center supports **150** and **155** are typically made of steel or stainless steel although other electrical conducting elements fall within the scope of the present invention.

In a further embodiment of the upper and lower center supports, upper and lower center supports **400** and **405** have notches **410** and **415**, respectively, which interconnect with the ends of the shroud **145**, as shown in FIG. **4**. The notches **410** and **415** and other elements constrain the shroud **145** both radially and axially.

FIG. **5** depicts a third embodiment of an upper center support **500**. The upper center support **500** is an electrical conducting strip containing two notches **505**. The electrical conducting strip **500** bends to surround the upper electrode lead **165** and hold the arc tube **140** in place. A second or lower center support **510** having two notches **515** may surround the lower leg portion **210** of the arc tube **140** for additional support. When the electrical conducting strip **500** is bent around the upper electrode lead **165**, the notches **505** line up and appear as a single notch with which the shroud **145** interconnects. Identically, when the lower center support **510** is bent around the lower leg portion **210** of the arc tube **140**, the notches **515** line up and appear as a single notch which the shroud **145** interconnects. Each center support **500** or **505** is coupled to the non-insulated main conductor wire **160** using the same manners previously described.

Returning to FIGS. **1** and **2**, while it is preferable to employ both the upper and lower center supports **150** and **155**, it is noted that only the upper center support **150** is necessary for supporting and centering the arc tube **140** as long as the distance between the stem lead **180** and the second conductor wire **170** is sufficiently small to provide adequate support for the lower end of the arc tube **140**. Further, the configuration of the upper and lower center supports **150** and **155** need not be identical. Rather, the configurations of the upper and lower center supports **150** and **155** may differ. For example, the upper center support **150** may be used with the upper electrode lead **165** while the lower center support **510** is used with the lower leg portion **210**.

The arc tube **140** and shroud **145** subassembly is manufactured by coaxially mounting the arc tube **140** and the shroud **145**. First, the upper center support **150** is placed on one end of the shroud **145**. The arc tube **140** is then inserted into the shroud such that the upper electrode lead **165** extends through the centering hole of the upper center support **150**. The centering hole is secured to the upper electrode lead **165**, preferably via welding, to insure an adequate electrical connection. However, other methods of establishing an electrical connection, such as crimping, may be used. The lower center support **155** is placed on the lower end of the shroud **145** such that the lower electrode lead **175** and lower leg portion **210** of the arc tube **140** extend through the centering hole **310** of the lower center support **155**. The lower center support **155** is electrically insulated from the lower electrode lead **175** emanating from the lower leg portion **210** of the arc tube **140**. As shown in FIGS. **1** and **2**, the lower center support **155** does not make an electrical connection with the lower electrode lead **175** because of the electrical insulating character of the leg portion **210** of the arc tube **140**.

In a further embodiment, the lower center support **155** is secured to an electric insulator instead of to the lower leg portion **210** of the arc tube **140**. The electric insulator, such as a sleeve, fits over and covers a sufficient portion of the lower electrode lead **175** to prevent an electrical connection between the lower center support **155** and the lower electrode lead **175**. The electric insulator may be any electrically insulating material such as a high temperature ceramic. For example, the insulating material may be an aluminum oxide ceramic.

The arc tube **140** and shroud **145** subassembly is then electrically secured to the non-insulated main conductor wire **160** by, for example, welding. This results in securing the shroud **145** in the axial direction. The lower electrode lead **175** is then electrically connected to the stem lead **180** by welding the second conductor wire **170** to the stem lead **180** and the lower electrode lead **175**. This connection may also be accomplished by directly connecting the lower electrode lead **175** to the stem lead **180** with a weld. The mount assembly is thereafter inserted into the outer envelope **105** through the inner diameter of the neck portion **125** and sealed to the outer envelope **105**.

FIG. **6** depicts a second embodiment of a mount assembly according to the present invention. The mount assembly includes the arc tube **140** and shroud **145** subassembly, the non-insulated main conductor wire **160**, and the second conductor wire **170**. The mount assembly may also include a getter **615**.

The arc tube **140** and shroud **145** subassembly includes the arc tube **140**, the shroud **145**, a center support wire **600** and upper and lower support stops **605** and **610**. The upper and lower stops **605** and **610** may be attached to or formed from the center support wire **600**. The getter **615** may be attached to the non-insulated main conductor wire **160** and the stem lead **180** near the stem **135**. The getter may be barium based. The getter **615** may also be zirconium based and located above the shroud and arc tube assembly, as seen in FIG. **1**.

The center support wire **600** is formed of three portions and is preferably a continuous wire. An upper lateral portion **620** is electrically connected to the upper electrode lead **165** in any number of manners. For example, the upper lateral portion **620** may be welded or crimped to the upper electrode lead **165**. The upper lateral portion **620** may also generally encircle the upper electrode lead **165**, as shown in FIG. **6**.

A second or spiral portion **625** of a sufficient diameter generally encircles the shroud **145**. Attached to the center support wire **600** between the upper lateral portion **620** and the spiral portion **625** is the upper support stop **605** which prevents the shroud **145** from moving axially in the upward direction. A lower lateral portion **630** mechanically attaches to an electrical insulator as the lower end of the arc tube to prevent an electrical connection between the lower electrode lead **175** and the center support wire **600**. For example, the lower lateral portion **630** generally encircles the lower leg portion **210** of the arc tube **140**, as shown in FIG. **6**. Attached to the center support wire **600** between the spiral portion **625** and the lower lateral portion **630** is the lower support stop **610** which prevents the shroud from moving axially in the downward direction.

The center support wire **600** preferably attaches to the non-insulated main conductor wire **160** at the slanted inward **250** and slanted outward **240** portions of the non-insulated main conductor wire **160** with welds. Together, the non-insulated main conductor wire **160**, the center support wire **600** and the upper and lower support stops **605** and **610** generally locate the arc tube **140** coaxially and laterally within the shroud **145**.

The arc tube **140** and shroud **145** subassembly is manufactured by first inserting the shroud **145** through the spiral portion **625** of the center support wire **600** until the shroud **145** rests between the upper and lower support stops **605** and **610**. The arc tube **140** is inserted into the shroud **145** such that the upper and lower electrode leads **165** and **175** extend through the shroud **145** at the respective ends. The upper electrode lead **165** of the arc tube **140** is then secured to the upper lateral portion **620** of the center support wire **600** preferably with a weld. The lower lateral portion **630** of the center support wire **600** is secured to the lower leg portion **210** of the arc tube **140** in any number of manners as long as an electrical connection between the lower electrical lead **175** and the non-insulated main conductor wire **160** is prevented. For example, the lower lateral portion **630** of the center support wire **600** may wrap around the lower leg portion **210** of the arc tube **140**.

The center support wire **600** is attached to the non-insulated main conductor wire **160** at a connection point below and a connection point above the shroud **145** to form the mount assembly. Preferably, the center support wire **600** is secured with welds to the slanted inward and outward portions **250** and **240** of the non-insulated main conductor wire **160**, as shown in FIG. **6**. The non-insulated main conductor wire **160** passes through the stem **135**. The non-insulated main conductor wire **160** may also be coupled to a second stem lead which passes through the stem **135**. As previously described in connection with the first embodiment of the electric lamp **100**, the lower electrode lead **175** is electrically connected to the stem lead **180** by welding the second conductor wire **170** between the stem lead **180** and lower electrode lead **175**. This connection may also be accomplished by directly connecting the lower electrode lead **175** to the stem lead **180** with a weld. The mount assembly is thereafter inserted into the outer envelope **105** through the inner diameter of the neck portion **125** and sealed to the outer envelope **105**.

FIG. **7** depicts a third embodiment of a mount assembly according to the present invention. The mount assembly comprises the same elements as the second embodiment depicted in FIG. **6**, with three exceptions. First, the non-insulated main conductor wire is of a different configuration. Second, the center support wire is omitted. Third, because the center support wire is omitted, the upper and lower support stops **605** and **610** are attached to or formed from the non-insulated main conductor wire. Thus, only the non-insulated main conductor wire, together with the upper and lower support stops **605** and **610**, generally locate the arc tube **140** coaxially and laterally within the shroud **145** in this embodiment.

In FIG. **7**, the non-insulated main conductor wire **700** is formed of five portions and surrounds the shroud **145**. A lower axial portion **705** extends through the stem **135**. A lower lateral portion **710** is mechanically attached to an electrical insulator at the lower end of the arc tube **140**. For example, as shown in FIG. **7**, the lower lateral portion **710** generally encircles the lower leg portion **210** of the arc tube **140**. A spiral portion **715** generally encircles or surrounds the shroud **145**. An upper lateral portion **720** is mechanically attached to the upper electrode lead **165**. As shown in FIG. **7**, the upper lateral portion encircles the upper electrode lead **165** and makes an electrical connection. While the electrical connection is preferably accomplished with a weld, it can be accomplished in other known manners, such as by crimping the upper lateral portion **720** of the non-insulated main conductor wire **700** to the upper electrode lead **165**. An upper axial portion **725** extends to the upper end of the outer envelope **105**. Preferably, a terminal loop **730** generally encircles the dimple **130** of the outer envelope **105** to limit movement of the arc tube **140** and the shroud **145** within the outer envelope **105** and improve rigidity of the entire assembly.

The arc tube **140** and shroud **145** mount assembly is manufactured by first inserting the shroud **145** through the spiral portion **715** of the non-insulated main conductor wire **700** until the shroud **145** rests between the upper and lower support stops **605** and **610**. The arc tube **140** is inserted into the shroud such that the electrode leads **165** and **175** extend through the shroud. The upper electrode lead **165** of the arc tube **140** is then secured to the non-insulated main conductor wire **700** and makes an electrical connection. For example, the upper lateral portion **720** generally encircles the upper electrode lead **165**, as shown in FIG. **7**. The lower lateral portion **710** of the non-insulated main conductor wire **700** generally encircles and secures to the lower leg portion **210** of the arc tube **140**, thereby preventing an electrical connection between the lower electrode lead **175** and the non-insulated main conductor wire **700**. The lower end of the arc tube **140** may be attached to the non-insulated main conductor wire **700** in any number of other manners as long as there is no electrical connection between the non-insulated main conductor wire **700** and the lower electrode lead **175**. The non-insulated main conductor wire **700** is then passed through the stem **135**.

As in other embodiments of the electric lamp, the lower electrode lead **175** is electrically connected to the stem lead **180** by welding the second conductor wire **170** to the stem lead **180** and lower electrode lead **175**. This connection may also be accomplished by directly connecting the lower electrode lead **175** to the stem lead **180** with a weld. The mount assembly is thereafter inserted into the outer envelope **105** through the inner diameter of the neck portion **125** and sealed to the outer envelope **105**. This lamp construction requires fewer components.

In summary, the present invention provides an improved electric lamp which addresses the above noted problems found in prior art lamps. The present invention provides an easier and more cost efficient lamp construction. The invention reduces the overall complexity of the assembly and provides a method for modular assembly of a metal halide lamp. The lamp also takes advantage of the fact that the passage of sodium through alumina ceramic arc tubes is suppressed by several orders of magnitude relative to quartz.

This lamp construction has a number of advantages over the prior art. The number of parts and welds required in this improved electric lamp are reduced by both electrically coupling and mechanically supporting a shroud and arc tube

utilizing only the non-insulated main conductor wire and upper and lower center supports. No additional support frame is needed.

Still another advantage is realized since the lamp construction removes the need for complex shroud assemblies.

Yet another advantage of this improved lamp assembly is that manufacturing is simpler because it provides for a modular assembly of the shroud and arc tube.

Furthermore, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired that the present invention be limited to the exact construction and operation illustrated and described herein. Accordingly, all suitable modifications and equivalents which may be resorted to are intended to fall within the scope of the claims.

What is claimed is:

1. An electric lamp comprising:

(a) a sealed light-transmissive outer envelope having an interior space;

(b) a base fixed to the outer envelope;

(c) a non-insulated main conductor wire within the outer envelope and connected to the base at one end;

(d) a light source capable of generating light within the outer envelope, the light source having first and second ends, the first end being electrically coupled to the non-insulated main conductor wire and the second end coupled to a stem lead;

(e) a shroud surrounding the light source, the shroud mounted adjacent the non-insulated main conductor wire; and

(f) a first center support that (i) electrically connects the first end of the light source to the non-insulated main conductor wire, (ii) supports the shroud and the light source, and (iii) mechanically couples the shroud and the light source to the non-insulated main conductor wire.

2. The lamp of claim **1**, wherein the light source is an arc tube.

3. The lamp of claim **1**, wherein the light source is a ceramic arc tube.

4. The lamp of claim **1**, wherein the shroud surrounds the non-insulated main conductor wire.

5. The lamp of claim **1**, wherein the non-insulated main conductor wire is located outside of the shroud.

6. The lamp of claim **1**, wherein the electric lamp is a metal halide arc discharge lamp.

7. The lamp of claim **1**, wherein the non-insulated main conductor wire is continuous from the base to a dimple.

8. An electric lamp comprising:

(a) a sealed light-transmissive outer envelope having an interior space;

(b) a base fixed to the outer envelope;

(e) a non-insulated main conductor wire within the outer envelope and connected to the base at one end;

(d) a light source capable of generating light within the outer envelope, the light source having first and second ends, the first end being electrically coupled to the non-insulated main conductor wire and the second end coupled to a stem lead;

(e) a shroud surrounding the light source, the shroud mounted adjacent the non-insulated main conductor wire;

(f) a first center support that electrically connects the first end of the light source to the non-insulated main conductor wire, supports the shroud and the light source, and mechanically couples the shroud and the light source to the non-insulated conductor wire; and,

(g) a second center support, the second center support mechanically coupling the non-insulated main conductor wire to the shroud and an electric insulator at the second end of the light source and being electrically insulated from an electric lead emanating from a second end of the light source.

9. The lamp of claim **8**, wherein the light source, the shroud, and the first and second center supports form an integral unit.

10. The lamp of claim **8**, wherein the electric insulator is a non-electrical conducting portion of the second end of the light source.

11. An electric lamp comprising:

(a) a sealed light-transmissive outer envelope having an interior space;

(b) a base fixed to the outer envelope;

(c) a non-insulated main conductor wire within the outer envelope and connected to the base at one end;

(d) a light source capable of generating light within the outer envelope, the light source having first and second ends, the first end being electrically coupled to the non-insulated main conductor wire and the second end coupled to a stem lead;

(e) a shroud surrounding the light source, the shroud mounted adjacent the non-insulated main conductor wire; and

(f) a center support wire that (i) is connected to a first lead emanating from the first end of the light source, (ii) encircles the shroud in a spiral fashion, (iii) is attached to the non-insulated main conductor wire at a first connection point above the shroud and at a second connection point below the shroud, and (iv) is continuous from the first connection point to the second connection point.

12. The lamp of claim **11**, further comprising stops connected to the center support wire which prevent the shroud from moving in an axial direction.

13. An electric lamp comprising:

(a) a sealed light transmissive outer envelope having an interior space;

(b) a base fixed to the outer envelope;

(c) a light source capable of generating light within the outer envelope, the light source having first and second ends, the first end being electrically coupled to the main conductor wire and the second end coupled to a stem lead; and

(d) a non-insulated main conductor wire within the outer envelope and connected to the base at one end, the non-insulated main conductor wire being mechanically and electrically coupled to the first end of the light source, mechanically attached to an electric insulator at the second end of the light source, and electrically insulated from an electric lead emanating from a second end of the light source;

(e) a shroud surrounding the light source and surrounded by the non insulated main conductor wire.

14. The lamp of claim **13**, wherein the non-insulated main conductor wire supports the shroud.

15. The lamp of claim **13**, wherein the non-insulated main conductor wire is mechanically attached to a first lead emanating from the first end of the light source.

16. The lamp of claim **13**, further comprising stops connected to the non-insulated main conductor wire which prevent the shroud from moving in an axial direction.

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